

Basic Exhaust Emission Rates for Tier 1 and Later LDVs & LDTs



John Koupal
MOBILE6 Workshop
June 29, 1999

Documentation



■ HC and NOx

- "Determination of NOx and HC Basic Emission Rates, OBD and I/M Effects for Tier 1 and Later LDVs and LDTs", M6.EXH.007 (Koupal)
- Corrected Appendix C (NOx charts) included in handout

■ CO

- "Determination of CO Basic Emission Rates, OBD and I/M Effects for Tier 1 and Later LDVs and LDTs", M6.EXH.009 (Glover)

Presentation Overview



■ Focus is Basic Emission Rates

- Does not include off-cycle or other effects
- No IM / No OBD (IM/OBD covered separately)

■ Outline

- Overall Approach/Assumptions
- NO_x
- HC
- CO
- Next Steps

The Challenge...



Estimate in-use emissions for vehicles which don't exist and/or for which extensive in-use data doesn't exist.

Basis of Emission Rates

■ NO_x:

- 186 Tier 0 LDV/LDTs certified to 0.4 g/mi standard in California (ARB Surveillance Data)
 - Used directly for Tier 1 LDVs
 - "Springboard" for post-Tier 1 LDV, all LDT

■ HC and CO:

- Emission rates developed for 1988-93 Ported Fuel Injection LDVs
 - "Springboard" for Tier 1 and later LDV/LDT

Overall Approach



■ Vehicles separated into three categories:

- "Normal" emitters: $< 2x$ 50K standard (3x for CO)
- "High" emitters: $> 2x$ 50K standard (3x for CO)
- "Repaired" emitters:
 - High emitters repaired through OBD and/or IM program
 - Repaired to 1.5x 50K standard

■ Categories combined by emitter weighting fractions, a function of vehicle mileage

Emitter Class Assumptions

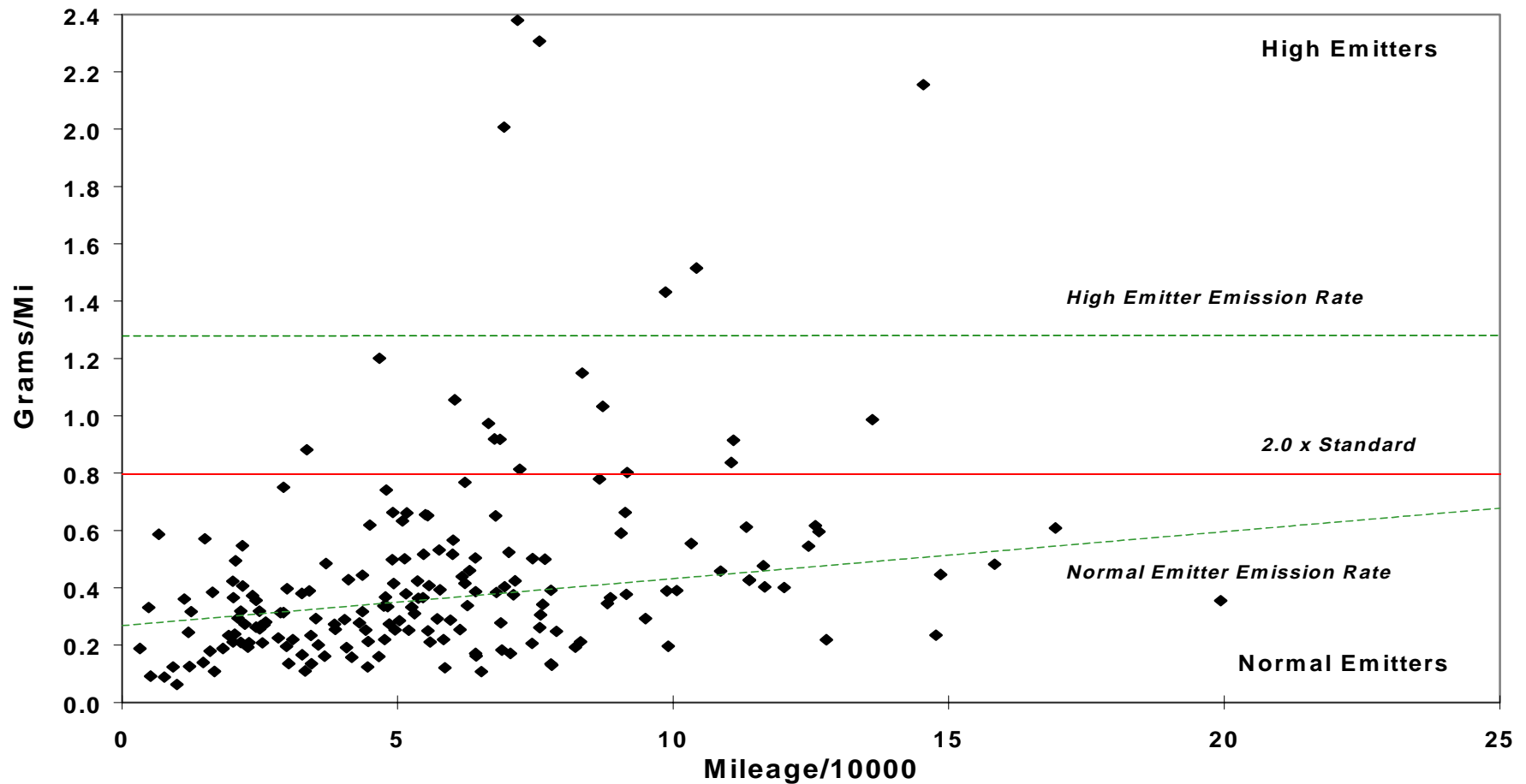
- Average emissions for Normal Emitters increase as a function of age (mileage)
- Average emissions for High and Repaired Emitters are constant across age
 - The fraction of these vehicles in the fleet does increase with age

NOx: Tier 1 LDVs



- ARB Surveillance Data on 0.4 g/mi LDV/LDTs used to generate “raw” emission levels for Normal and High Emitters.

NOx: Tier 1 LDVs



NOx: Tier 1 LDVs

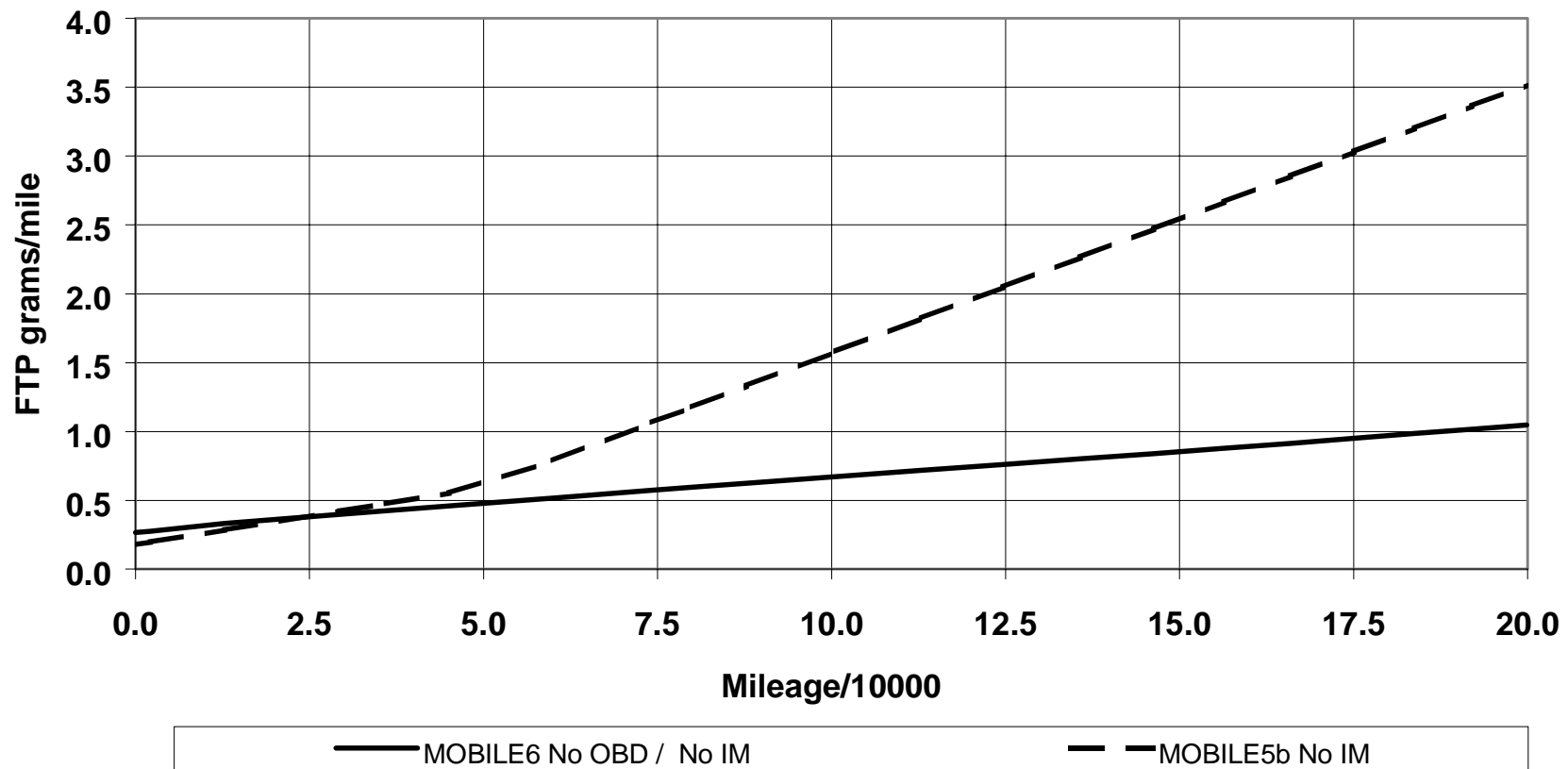


- ARB sample average adjusted upwards to:
 - Account for high emitter recruitment bias
 - Remove the estimated effects of California's I/M program

- High emitter fractions derived using
 - "Raw" normal/high emission levels
 - Adjusted sample average

Proposed MOBILE6 vs. MOBILE5b

Tier 1 LDV NO_x Without I/M



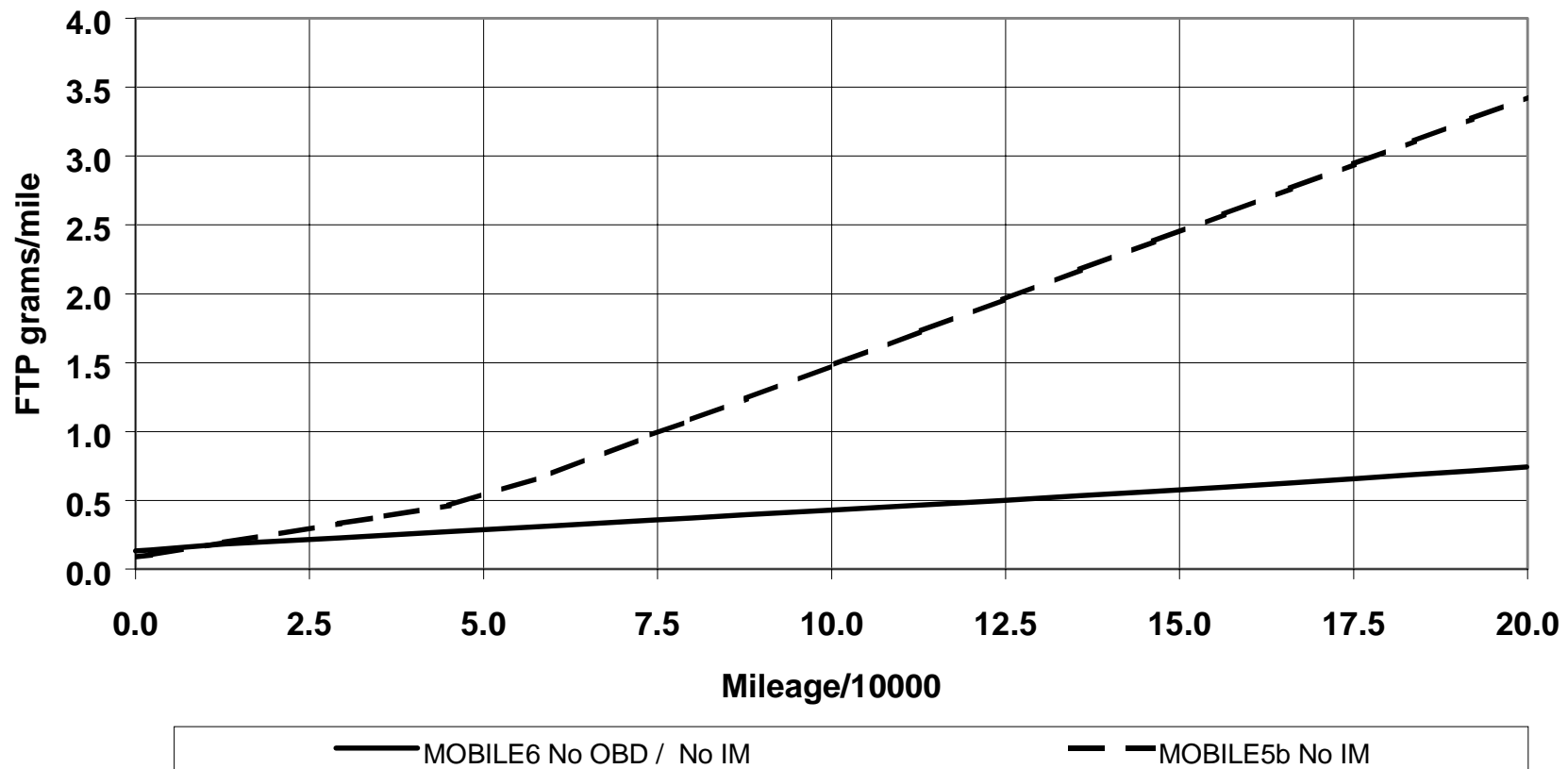
NOx: Post-Tier 1 LDVs



- “Normal” emission rate reduced in proportion to ratio of 50K standards
- “High” emission rate reduced by 50% of 50K standard ratio
- High emitter fraction unchanged from Tier 1

Proposed MOBILE6 vs. MOBILE5b

LEV LDV NO_x Without I/M



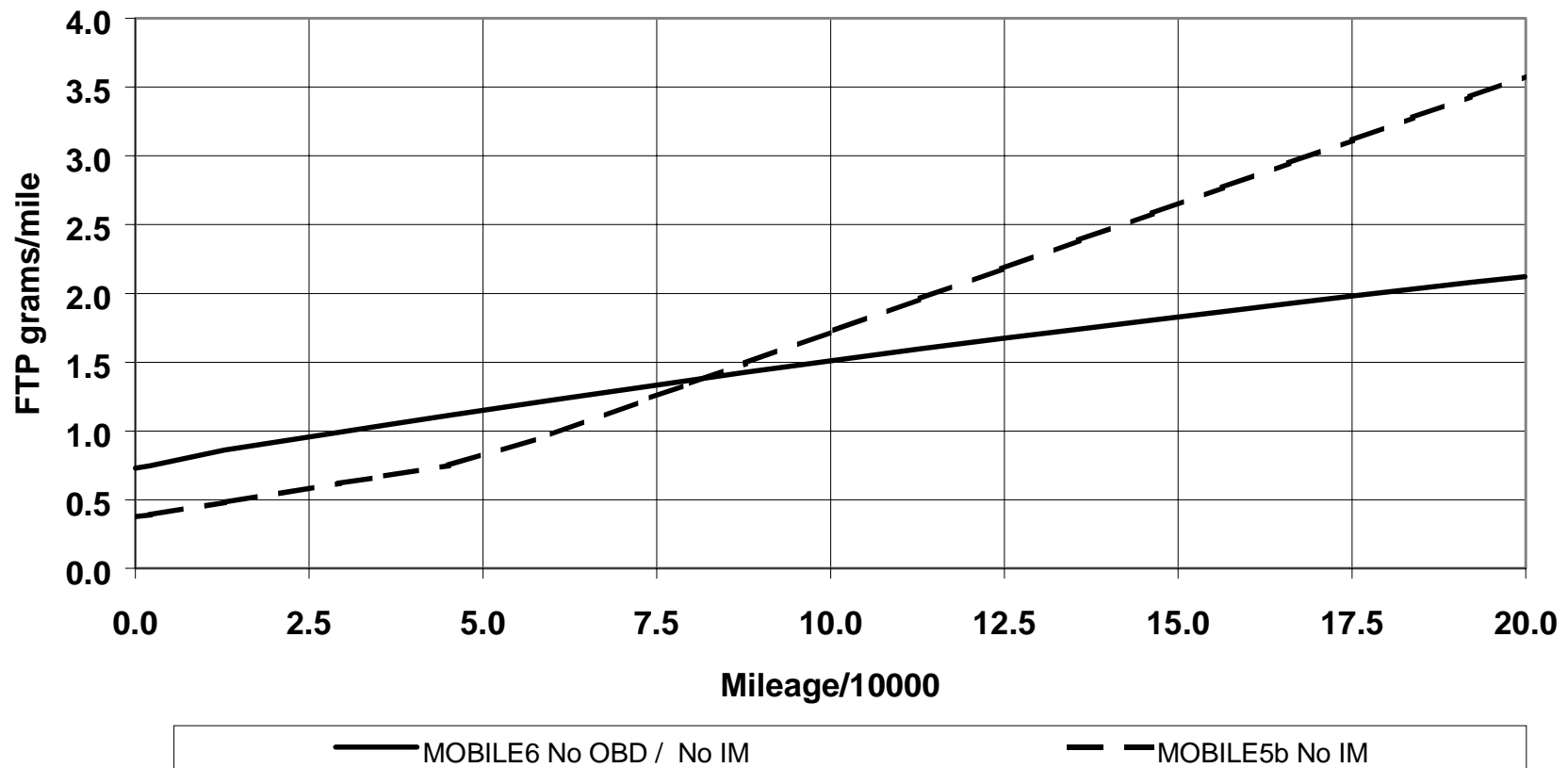
NOx: Tier 1 and Later LDTs



- Overall assumption: emission characteristics of LDVs and LDTs will be the same in use.
- Tier 1 LDV emission rates used as basis:
 - “Normal” emission rate adjusted in proportion to ratio of 50K standard to Tier 1 LDV 50K standard
 - “High” emission rate adjusted by 50% of 50K standard ratio
- High emitter fraction = Tier 1 LDV

Proposed MOBILE6 vs. MOBILE5b

Tier 1 LDT4 NOx Without I/M



HC: Tier 1 and Later LDVs and LDTs



- Approach identical to NO_x, except that emission rates and fractions for 1988-1993 PFI LDVs formed the basis

HC: Tier 1 and Later LDVs and LDTs

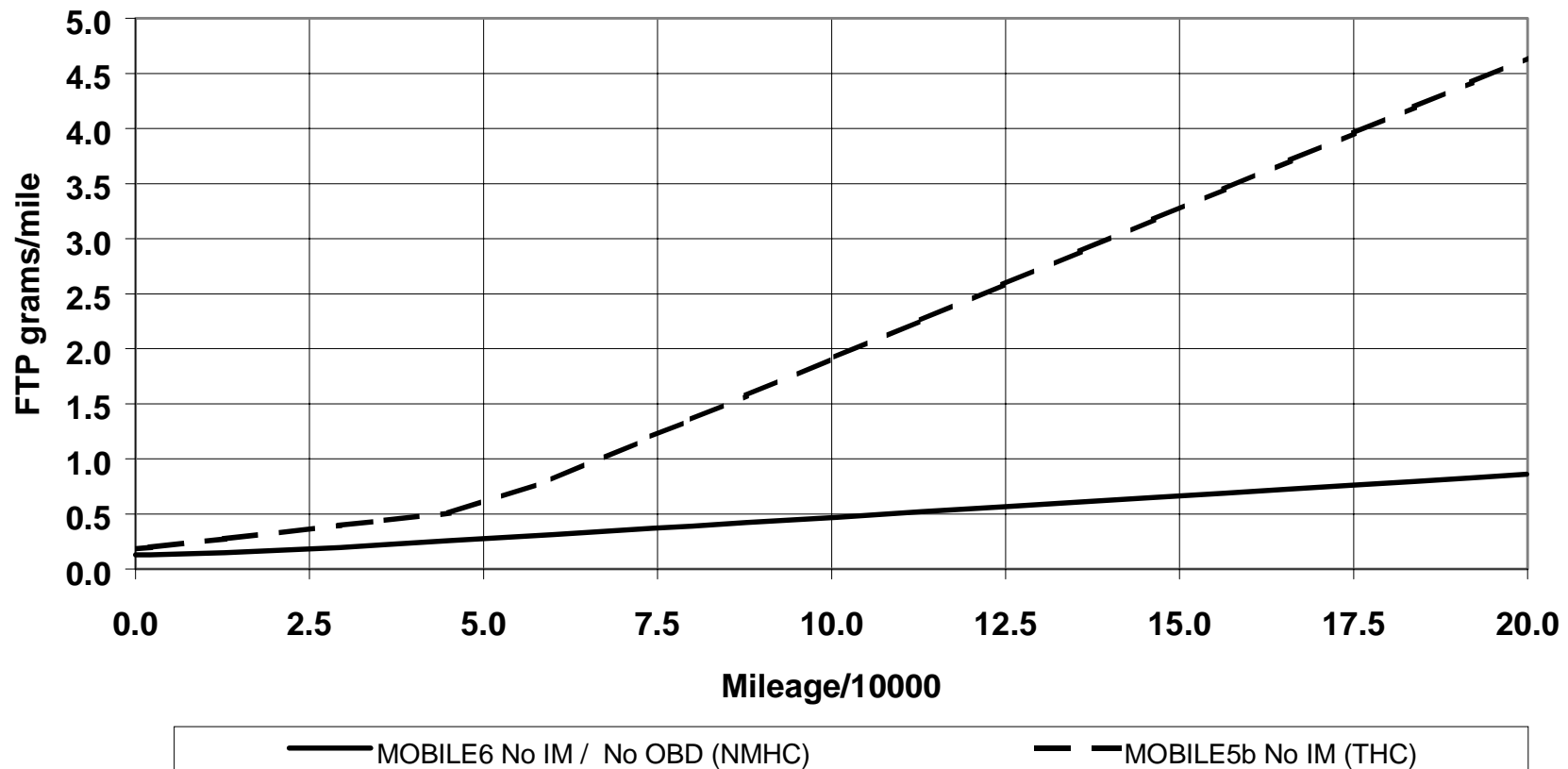


■ Assumptions:

- “Normal” emission rate reduced in proportion to ratio of 50K standard to Tier 0 LDV standard
- “High” emission rate reduced by 50% of 50K standard ratio
- High emitter fraction unchanged from 1988-1993 Tier 0 PFI LDVs

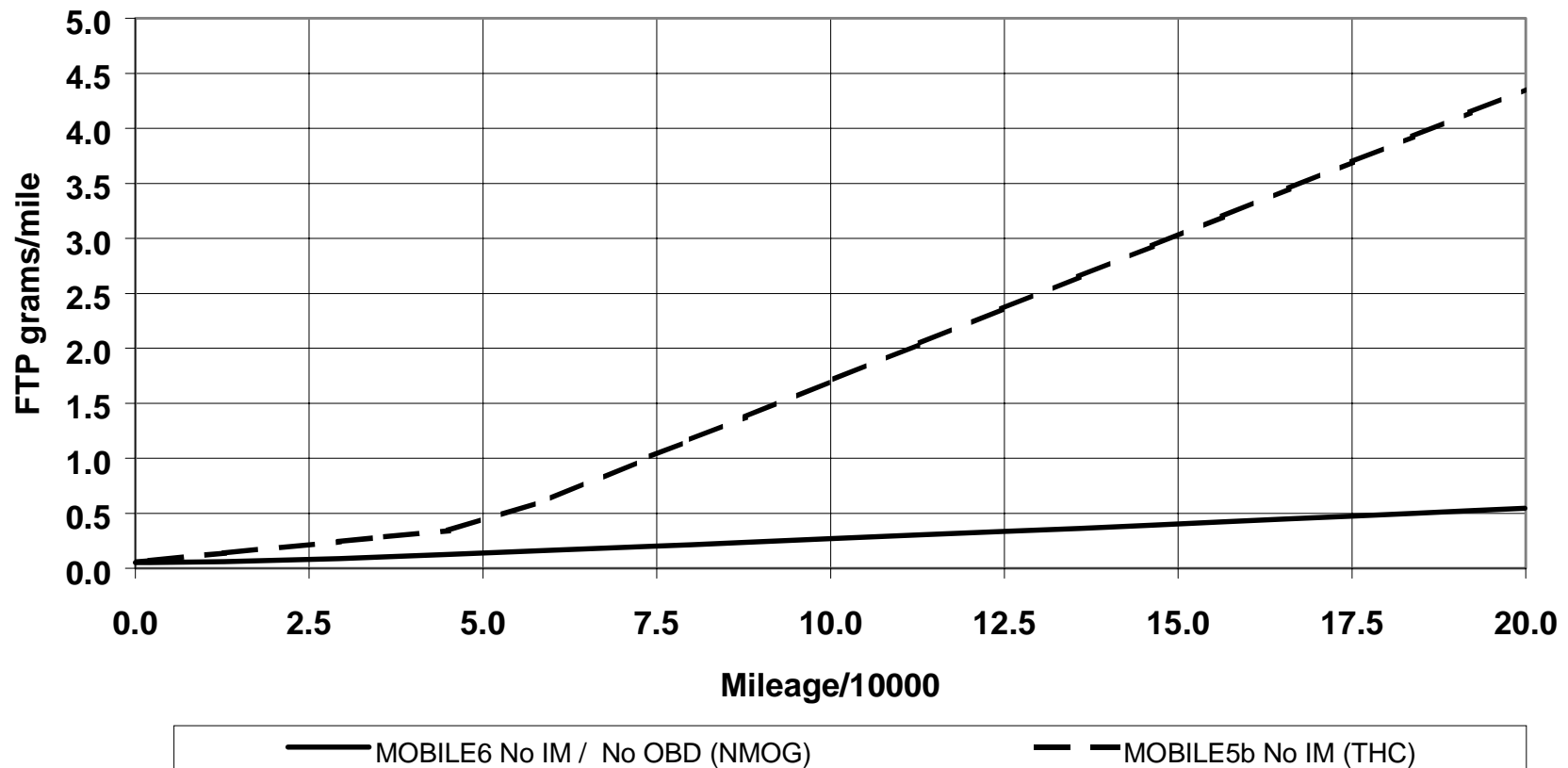
Proposed MOBILE6 vs. MOBILE5b

Tier 1 LDV HC Without I/M



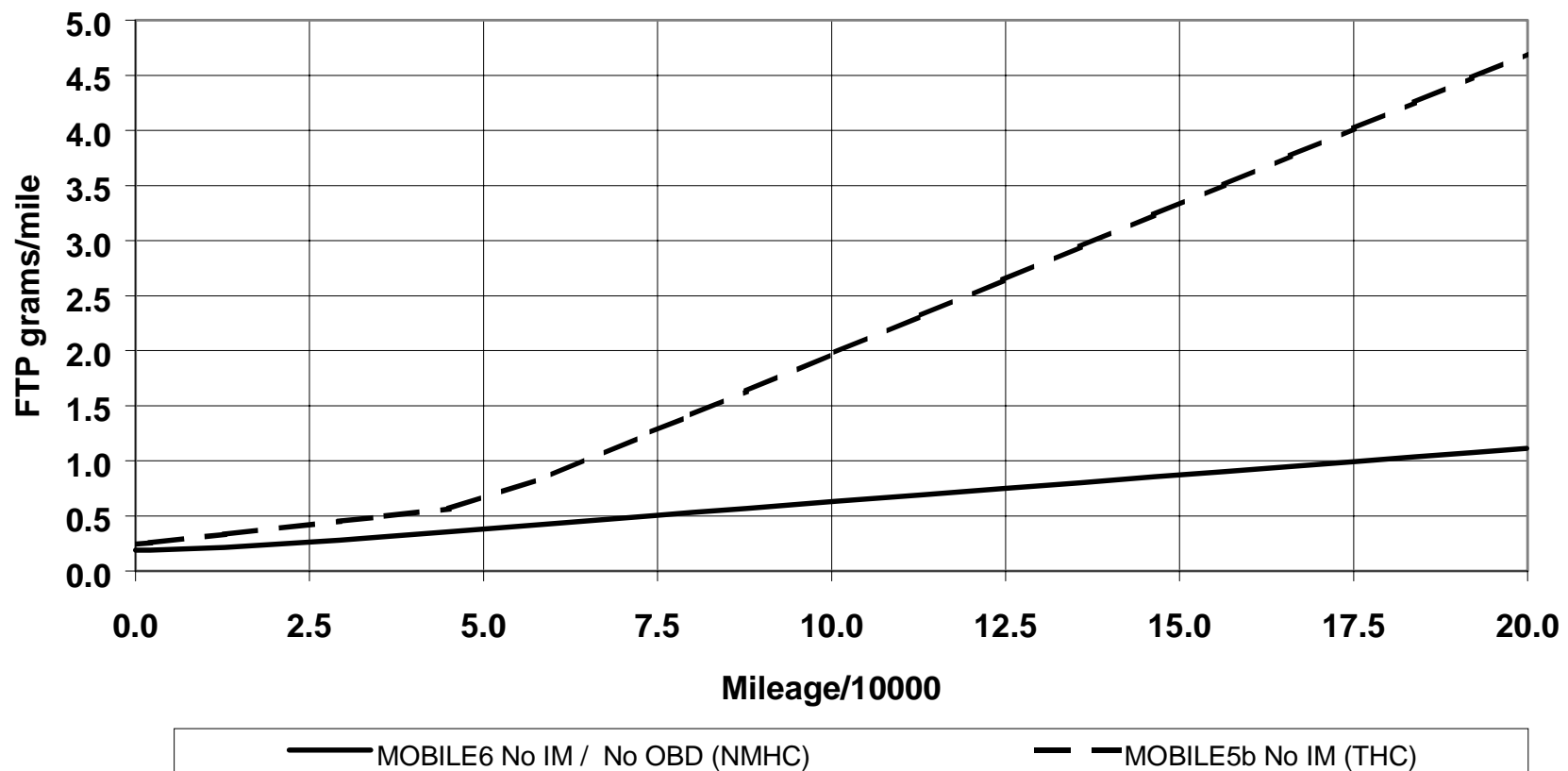
Proposed MOBILE6 vs. MOBILE5b

LEV LDV HC Without I/M



Proposed MOBILE6 vs. MOBILE5b

Tier 1 LDT4 HC Without I/M



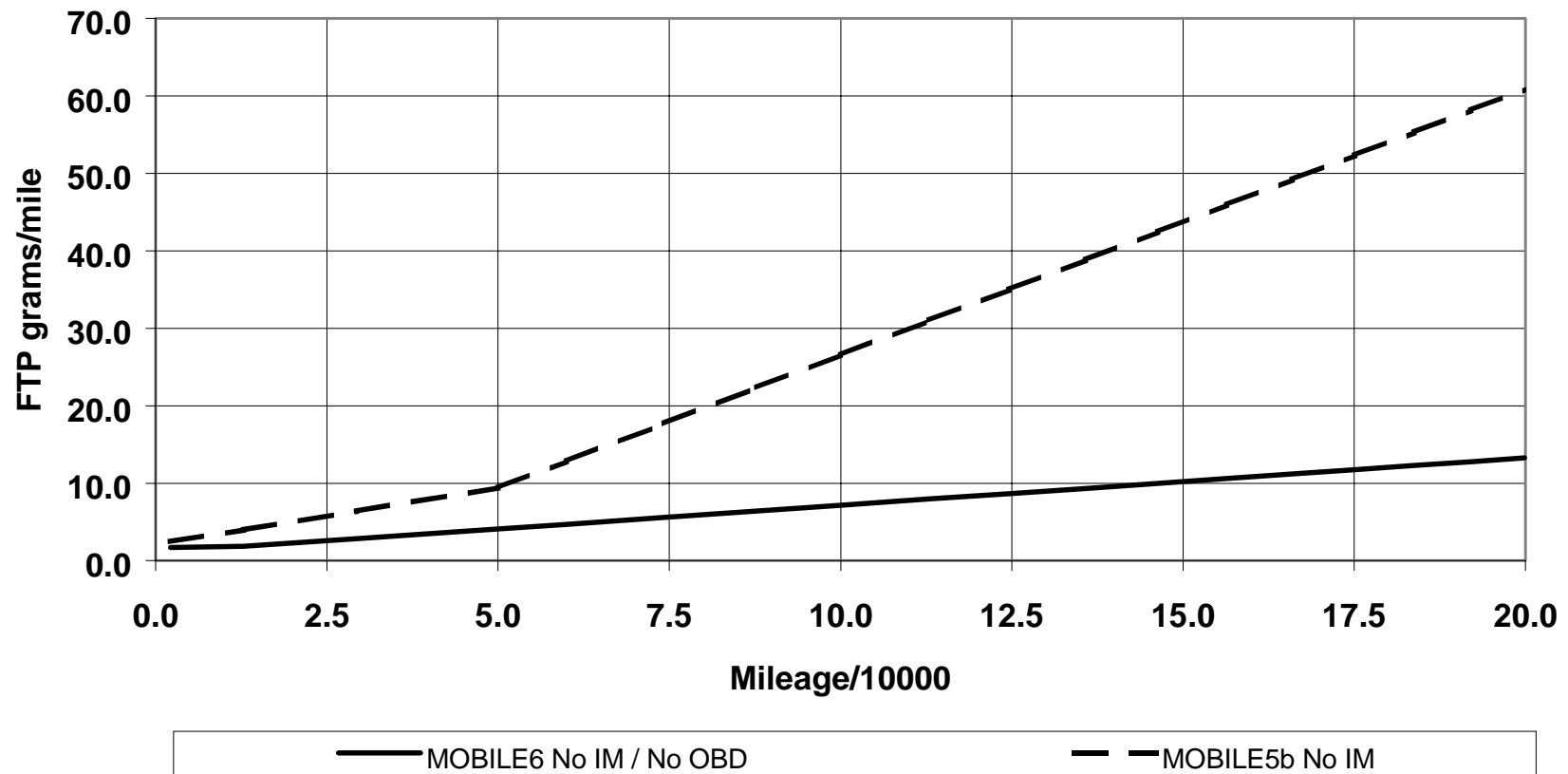
CO: Tier 1 and Later LDVs and LDTs



- EPA data on 1994 and later LDVs and LDTs used to determine normal emitter zero mile level (ZML)
 - ZML reduced by ratio of standard for ULEV
- Normal emitter DR, high emitter emissions and high emitter fractions from 1988-1993 PFI LDVs and LDTs used as is for all standard levels

Proposed MOBILE6 vs. MOBILE5b

Tier 1 LDV CO Without I/M



Separation of Running and Start



■ HC and NOx:

- Emission rates developed in FTP space
- Running/Start splits applied to FTP results
 - Tier 1: SFTP dataset
 - LEV: MOBILE6 Sulfur dataset

■ CO:

- Emission rates developed in Running/Start space

Next Steps: *Additional Data*



■ Additional data exists which needs to be considered:

- Auto Industry data on over 800 0.4 NOx vehicles
- EPA data on over 100 Tier 1 vehicles
- EPA/FACA OBD testing

Initial assessment: These are relatively low mileage data, likely most useful for characterizing normal emitter emissions and the frequency of high emitters on newer vehicles

Next Steps: *Preliminary Auto Comments*



- Full useful life standards will inherently reduce deterioration
 - Very preliminary analysis of ARB NO_x and EPA Tier 1 data suggests lower intercept, higher DR for Tier 1 vs. Tier 0
- Compliance margin is greater for LDTs
 - Will need to be assessed based on in-use data
- Lowering the HC standard results in CO reductions as well

Next Steps: *Other Issues*



- High emitter adjustment to account for recruitment bias
- Frequency of high emitters at low mileage
- High emitter definition
 - Change to 1.5x standard to better model OBD?